CEMENT
AND
CEMENT MANUFACTURE
INCORPORATING "PORTLAND CEMENT"

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Scientific Control in Cement Manufacture.

THE technical efficiency of cement manufacture is making steady progress year by year and for this much credit is due to the designers of rotary kilns and tube mills. It is now possible to purchase cement-producing plant with guarantees of high efficiency which can be maintained so long as the plant is kept in good order. It is, however, frequently the case that a manufacturer desires to increase the output of a factory without additions to machinery, and this is usually done by speeding up fans and mills and raising chimney dampers without much regard to scientific rules, the result being that efficiency is lost and there is virtually a return to rule-of-thumb control. This need not necessarily be so if alterations to the running of plant are done on a scientific basis, but it must be admitted that the technique for this is not available in many factories. The cement-works official who desires to apply scientific control to rotary kilns, for example, must be able to measure air-flows, calculate heat quantities, and work out heat-balance sheets; for this purpose he must have more than a smattering of physics, chemistry, and engineering, and have at his elbow the necessary books of tables connected with these three sciences.

This combination of knowledge and literature, together with the leisure for elaborate calculations, rarely exists on cement works, and it is only the larger manufacturing organisations with headquarters staff that can seriously tackle the problems of heat efficiency in rotary kilns. There is accordingly room for specialised literature for cement works use giving simplified formulæ and the necessary tables of data for rapid calculation. Although not indicated in the title, the author in compiling this book* evidently had the needs of the cement industry prominently in his mind. The early chapters indeed raise the hope that here is a *vade-mecum* (if such a term can be applied to a book weighing 4 lbs.) for cement works managers and engineers. One of the merits of the book is that it starts from first principles and gives explanations which should be comprehensible by all who are inspired by the ideal of scientific control,

* "A Treatise on Chemical Engineering," by Geoffrey Martin.

no matter what may be their stage of education. In this connection the author's experience as a teacher has served him well, because as a rule he assumes that his reader is quite ignorant of the subject.

The book as a whole deals with the flow of air and other gases, water and other liquids, and more briefly with the flow of powders under the influence of pneumatic transport. It can thus be seen how closely connected are these subjects with the cement manufacturing processes where the flow of air for rotary-kiln combustion, the flow of slurry through pipes, and the propulsion of powdered-coal into the kiln or ground cement into bins by pneumatic transport, are matters upon which success or failure depend. In the first chapter methods are described of calculating the air-supply of rotary cement kilns and the dimensions of the air-ducts and pressures required in connection therewith. Appropriate tables are given relating water-gauge measurements with air quantities at various temperatures, and also ready-reckoning tables connecting diameters and areas of pipes and ducts to facilitate rapid calculation. Useful chapters are those giving the principles of the Pitot tube and its practical application to measurement of air and gas quantities, including the various types of manometers that can be used. In each case it is shown how the formula to be used for calculation is evolved, and several examples of the application of the formulæ are given, many of them being solutions of rotary-kiln problems such as the calculation of the velocity of hot air entering a rotary kiln when the dynamic pressure (W.G.) and temperature are measured.

In successive chapters the effect of viscosity on fluid flow is discussed, formulæ are worked out, tables of viscosities of gases and liquids are given, and viscometers are described. Then follows the important subject of pipe friction for gases and liquids, with the necessary consideration of stream-line motion and turbulent flow. The power requirements for moving gases and liquids naturally enter into these chapters, and the reader is enabled to calculate the fan power required for the induced draught of a rotary kiln, the power required by an air-compressor for a certain duty, the power required for pumps to transport slurry a given distance through a pipe-line, and many of the other problems which confront a cement works engineer. Following an exposition of Bernoulli's theorem, the principles of the Venturi meter are described with particulars of meters of this and other types on the market. This section of the book concludes with 50 pages of tables giving volumes and weights of the gases at temperatures coming within the purview of the rotary-kiln controller.

The final section of the book treats somewhat too briefly with some of the basic principles related to pneumatic transport of powders and air separation, but the subject is not developed far enough to be of much practical help to the cement manufacturer.

Enough has been said to show that the book goes some way towards satisfying the needs of the cement works official who has not had an all-round scientific training; it is certainly the most useful book yet published for this particular purpose, although another volume of equal size requires to be

written on the thermal aspect of rotary kilns and the theory of tubemill grinding. When the time comes that rotary kilns are under the direct control of scientists instead of semi-skilled labourers there will be a greater demand for such a text-book which may warrant its publication. Although the scope of the book is admirable, it is not beyond criticism in detail and needs editing to improve the grammar, to remove repetition, and to add here and there some explanations which are needed for the benefit of the novice.

[Copies of "A Treatise on Chemical Engineering" are obtainable from the Book Department, "Cement and Cement Manufacture," 20, Dartmouth Street, London, S.W.1, price 64s., including postage to any part of the world.]

The Cement Bacillus.

AT the Research Station of the American Bureau of Standards some work has been done in preparing, in chemically pure form, the sulpho-aluminate of calcium which has been considered responsible for the destruction of concrete when submitted to the percolation of sea water. Candlot in 1890 was the first to call attention to the existence of this compound and its effect upon concrete, and it gained the name of the "cement bacillus" either because of the resemblance of the crystals to bacilli or because it was the cause of the "disease" that destroys permeable concrete in sea water.

The American research workers have now established that two calcium sulpho-aluminates exist, expressed by the respective formulæ—3 CaO. Al_2O_3. 3 $CaSO_4$. 31 H_2O. and 3 CaO. Al_2O_3. $CaSO_4$. 12 H_2O. The latter compound is not stable in water and is readily converted into the former, which is therefore the significant compound in respect of decomposition of cement. The stable sulpho-aluminate is formed by mixing solutions of calcium aluminate (5 CaO, $3Al_2O_3$), calcium sulphate, and calcium hydroxide, thus repeating the conditions which may occur in the interior of a porous concrete. Well-defined crystals were produced and the optical properties were determined. Calcium sulpho-aluminate is completely decomposed by solutions of magnesium salts, and this may be a factor in the destruction of concrete as well as the swelling which is believed to accompany the formation of the sulpho-aluminate.

Canadian Developments.

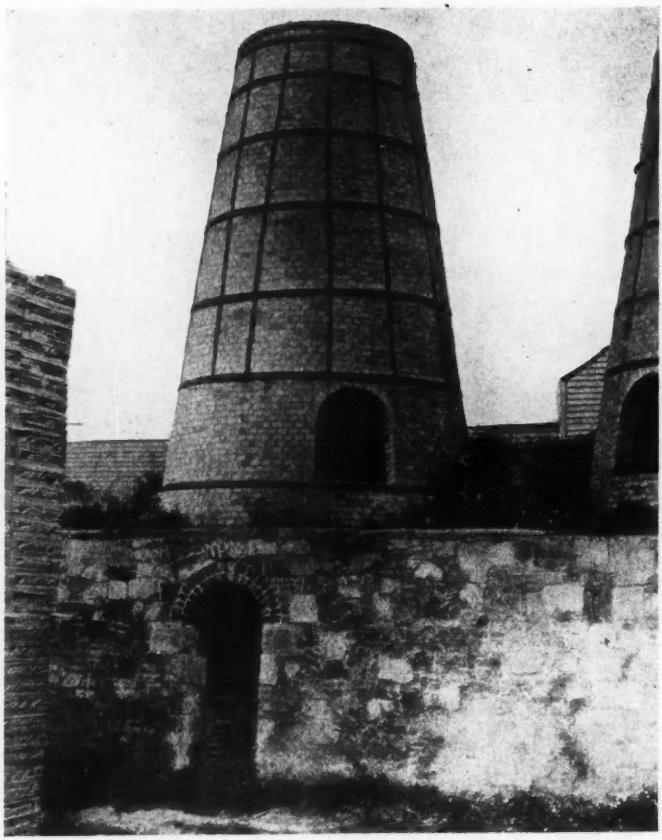
The Canada Cement Company is to erect large cement bins in Toronto having a storage capacity of 100,000 barrels. The cement is stored in bulk, and bagging machinery is to be installed and the cement packed and delivered direct from this plant.

Burning or Calcining.

By A. C. DAVIS, M.I.Mech.E., M.Inst.C.E.I., F.C.S.

(*Works Managing Director, Associated Portland Cement Manufacturers, Ltd*)

FOLLOWING the scientific mechanical preparation of the raw materials for Portland cement as already described in this series of articles, the burning or calcining of these mixtures at a high temperature and to a point of slight vitrification is the next operation, producing what is known as "clinker." Before describing the more modern methods of burning it will be of historical interest to review briefly the earlier methods adopted, and it will also assist



Early Kiln used by Aspdin's Son at Northfleet.

to a better appreciation of the evolution in the manufacture which has taken place in recent years.

In the raw materials, the carbonate of lime, silica, and alumina are in a chemically uncombined state, but, in converting them into cement clinker by burning, the silica and alumina of the clay enter into combination with the lime forming calcium silicates and aluminates. These compounds are the important constituents of Portland cement, but no commercial cements are made up wholly of these three ingredients because the raw materials are never quite pure. It is found, for instance, that in the operation of burning, iron

A Row of Bottle Kilns at Messrs. Robbins & Aspdin's Works at Northfleet, Kent.

oxide behaves in the same way as alumina, and that a good cement could be made if the alumina were replaced by iron oxide.

The calcining process is a purely chemical one, and, just as the mechanical mixing of the raw materials can make or mar the quality of the cement, so may the burning, if improperly carried out, destroy the value of the finished product. If the kiln temperature is too high the kiln is damaged and fuel is wasted; on the other hand, if the heat is insufficient the necessary chemical changes do not take place, and again an unsatisfactory result is obtained.

Satisfactory burning is indicated by the formation of a dense greenish-black clinker. Light-burned clinker is yellow or brown in colour and soft, while over-burned clinker is fused and slag-like. Excess of clay or imperfect raw-

mixing may cause the clinker to " dust " or fall to powder on cooling, but this defect was much more common in the earlier vertical kilns than with modern rotary kilns, as the better control of burning by the latter process is most beneficial in the production of good and uniform clinker.

Tests show that the temperature obtained in the kiln for normal Portland cement (76 to 77 per cent. $CaCO_3$) is about 1,400 deg. C., or, say, 2,550 deg. F. A reduction in carbonate of lime reduces the calcining temperature slightly, but it may be said that the temperature usually required to bring normal raw materials to the point of incipient fusion is about 2,500 deg. F. The higher the percentage of lime the higher the temperature necessary to produce complete diffusion in combination with silica, and the greater the necessity for a large surface area of contact. The finer the grinding of the raw mixture the higher the percentage of lime which can be carried.

It will be seen that a proper chemical composition of the raw materials is no guarantee that the resulting cement will be satisfactory, because if they are improperly burned the materials may not have attained thorough diffusion, and consequently may not be in equilibrium. It is therefore essential that the very closest attention be given to the burning operation, which is a process requiring experience and care.

Until recent years the burning of cement has not had close attention and study from a scientific point of view, but with the advent of the rotary kiln better facilities were afforded for such investigation, and much scientific knowledge and practical improvement to-day are being attained from the use of this method of burning.

Many kilns for burning cement in the old days were of either an " intermittent " or a " continuous " character, among the earliest being dome or " bottle " kilns, followed later by chamber kilns and others to which the names of the designers were sometimes applied, such as Batchelor, Johnson, Dietsch, Hoffman, Aalborg, Stein, Schneider, and, lastly, the kiln now generally adopted —the rotary kiln.

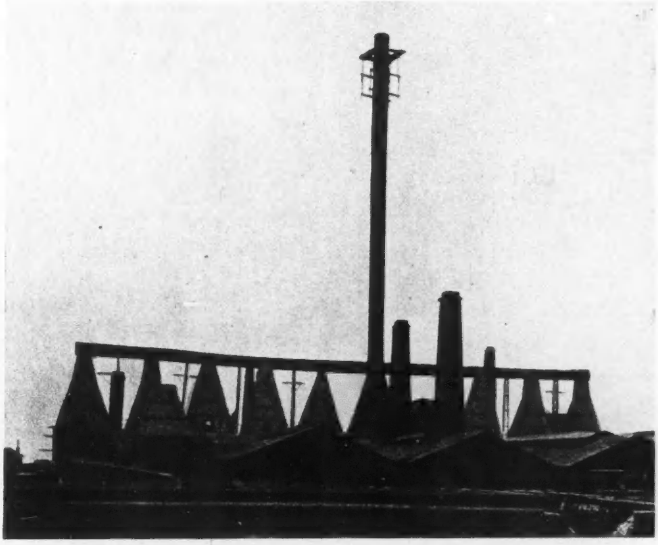
Burning in intermittent kilns necessitated distinct loading and drawing operations, the kiln being stopped during the drawing of the clinker and recharging of the next load. The loading, burning, and drawing of the intermittent kiln occupied some five to six days. This method is now quite obsolete.

In continuous kilns the burning of the raw material is continuous, the " loading " of the kiln and the " drawing " of the clinker taking place at the same time while the burning proceeds without interruption, thus making a continuous process. Continuous kilns are generally costly to construct and require skilled labour for their operation. These kilns were, however, economical in fuel, and when they succeeded the intermittent kiln the calcining process became much more regular and the cement of better quality.

The intermittent dome kiln was originally the only type employed in the industry. The consumption of coke (the fuel used) amounted to about 40 per cent. of the weight of clinker produced. The first step in loading bottle or dome kilns, and also chamber kilns, was first the careful arrangement of faggots on the bars of the kiln to start the fire, followed by alternate layers of coke and

raw material until the kiln was filled, the layers of fuel and raw material gradually decreasing somewhat in thickness towards the top. In this way the heat was distributed more regularly over the kiln when it was fired.

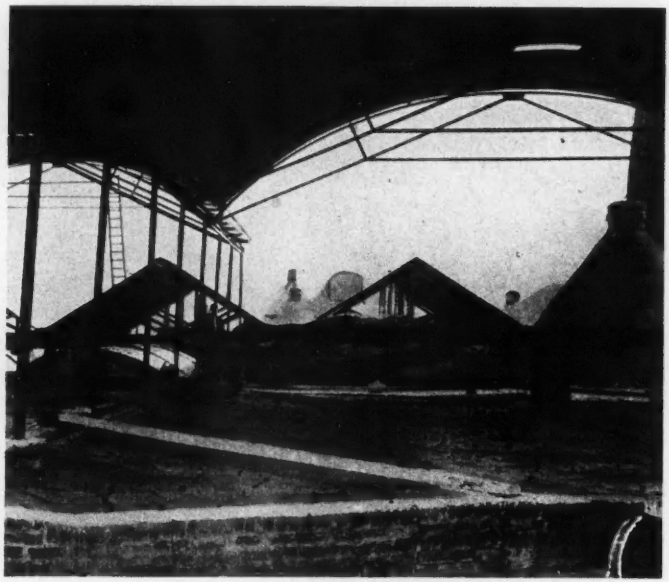
In this method of burning the following sequence of events took place: When the coke became ignited by the firing of the faggots the moisture from the raw material was expelled, and with the subsequent red heat the carbonic acid gas was driven off. The final stage in the burning was approached when the temperature increased to almost a white heat of 2,000 deg. to 2,500 deg. Fahr., causing the material to become slightly vitrified. Layer after layer of the raw



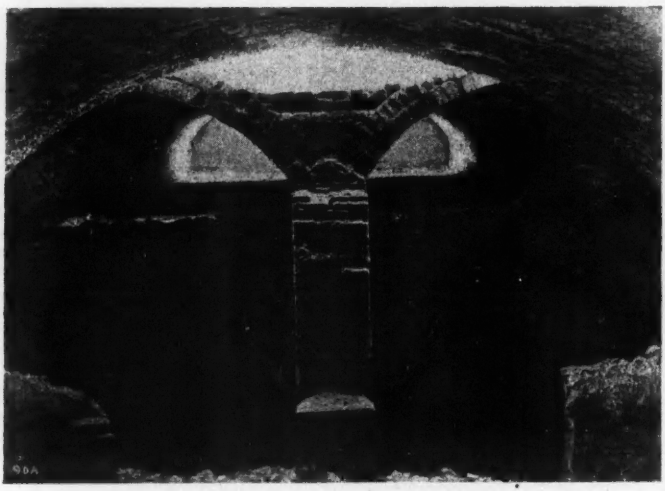
Early Bottle Kilns Connected by Common Iron Flue to an Iron Chimney.

material was thus calcined into "clinker." With the "intermittent" kilns this process went on until the whole of the contents of the kiln were burned through and the clinker had then to be allowed to cool down before the unloading of the kiln took place, an operation which was very hot and laborious for the men.

The kiln was of the simplest type of construction. The chamber was usually egg-shaped, and, as explained, the lumps of raw material and coke were spread in alternate layers. The estimation of the proper amount of fuel required experience, since the draught varied with the prevailing wind, and this method of burning was more or less at the mercy of the elements. The amount of over-burned and under-burned clinker was proportionately large and the output small. The cost of labour and fuel was very high.

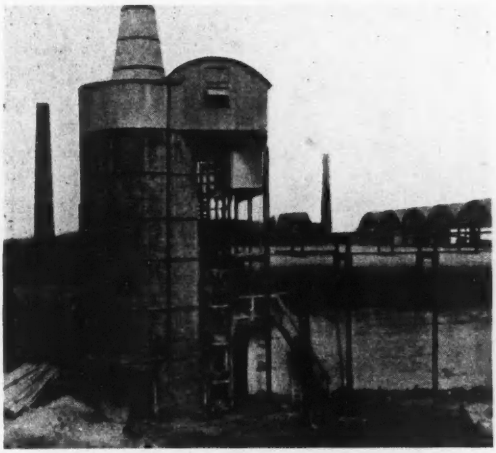


Slurry Drying Floors.



Drying Chambers of Batchelor Kilns.

The chamber kilns were undoubtedly a great advance on the earlier kilns, economy being effected by the hot gases from the fire passing over wet slurry previously spread on covered floors, and drying it for the next charge; the kiln proper was at one end of the covered floor or chamber and the chimney stack at the other. These kilns were also intermittent, however, and only produced a small output with considerable labour and costly fuel. Trouble was also likely to occur if the burner lacked experience. If the proportion of water in the slurry was not kept down as low as possible the drying was retarded by the excess water. Again, if the " slip " put into the kiln was not dry the moisture when driven off condensed on the surface of the slurry in the chamber, and had therefore to be expelled before the drying of the slurry commenced. Then there was



Schneider Kiln Adapted for Burning Surplus Slurry from Chamber Kilns (shown on right).

the possibility of the " slip " falling away to dust in the kiln and interfering with the draught. The gases sometimes accumulated above the kiln and the air drawn in through cracks that always appeared in the brickwork from expansion caused by the heat formed an explosive mixture which, as soon as the fire appeared on the top of the kiln, was ignited, with the result that the ends of the kiln were blown out. It was advantageous with these kilns to carry away the gases and steam, without passing them over the slurry, until the kiln " dropped," or, in other words, until the fire broke its way through the material in the kiln. If this was done two feet of slurry in the drying chamber could be dried in twenty to thirty hours by careful regulation of the draught.

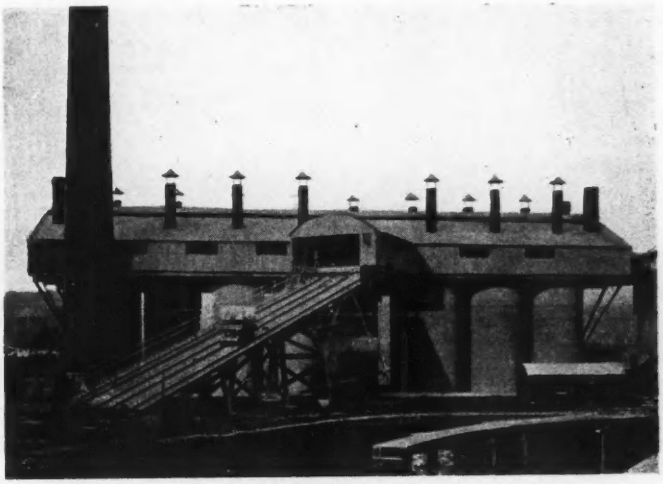
These kilns were usually designed to give about 30 tons of cement at each charge, and draught was provided by a chimney which was sometimes quite short. Given ordinary attention, however, quite a good cement was manufactured by this process of burning, which sufficed in the industry for some decades.

The Batchelor kiln was constructed on somewhat similar lines to the chamber kiln, with the difference that instead of the single drying chamber a series of slurry-drying chambers was provided at the back of the burning portion of the kilns by two or three arched chambers arranged one above the other. One big chimney usually served for a block or group of kilns. The Batchelor kiln again was costly in labour and fuel (coke), although giving good results.

With the continuous kilns formerly used in England—most of which have been mentioned earlier—the heat was kept up by the regular feeding of the coal or coke with the raw material. The principal difference between what may be described as the old method referred to above and the continuous kilns here referred to was that instead of burning the kiln right out, cooling off, and drawing all the clinker each time, the burning of the kiln rarely ceased except for repairs; this showed considerable economy, since the heat was constant and the cold air travelled up through the burnt clinker at the bottom of the kiln, which it cooled, and was at the same time itself heated on its way to the fire zone. In turn the heated gases leaving the fire zone parted with the greater portion of the heat to the raw material travelling downwards (towards the fire zone) when passing through the kiln on the way to the chimney. The economy of a continuous kiln of this type was shown by the low temperature of the gases when they reached the chimney, the reduction being so great that although the temperature must have been some 2,500 deg. Fahr. at the fire zone of the kiln the hand might easily be held in the gases leaving it. There is no doubt that a considerable saving of fuel (some 50 per cent.) was effected by the adoption of the continuous type of kiln, as great loss was involved in the constant cooling and heating in the interval between unloading and loading of the older kilns previously mentioned.

The Dietsch kiln, though never in general use in England, was one of the examples of the early continuous kiln. The dried slurry, or raw material in the form of bricks, was introduced at the base of the stack into what may be called the heating chamber, which was always full. Below this was a right-angle flue with a short horizontal section over which the hot slurry was drawn by long shovels to fall into the burning chamber, after which it was fed with a layer of coal by hand labour. The burnt clinker in the bottom part of the kiln was cooled by the air entering through the grates, while the slurry in the upper chamber was heated by the gases escaping from the burning zone. At intervals a portion of the clinker, partially cooled, was removed at the bottom, causing a general settlement in the kiln and leaving a space at the top into which the dried slurry was raked and more fuel added as described. This kiln took small coal for fuel and was more economical than the intermittent types, using only some 20 per cent. of coal upon the weight of clinker produced.

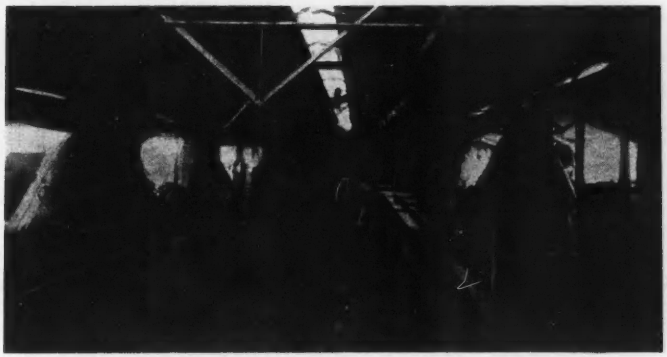
The Hoffman kiln met with very little success in this country, as the wet process of manufacture was generally adopted, and the kiln was essentially designed for the dry method. It consisted of a series of compartments built round a large central stack, and communicating by means of flues in such a way that the smoke and hot gases from one chamber might be passed through others before reaching the chimney. The kiln might be either " up draught " or



A Battery of Schneider Kilns.

" down draught " according to the direction in which the heat was drawn through the chamber. The compartments were charged from the sides, and when the moisture had been driven off from the material in the chamber first fired, the gases from this chamber were passed through the adjacent chambers which had in the meantime been filled with raw material. Although this kiln was economical of fuel if run continuously, much labour, entailing heavy costs, was required to charge and empty it.

The Aalborg kiln used on the Continent was almost unknown in England. It consisted of an upper heating chamber and a central combustion chamber of reduced diameter. The construction details had been carefully arranged and the

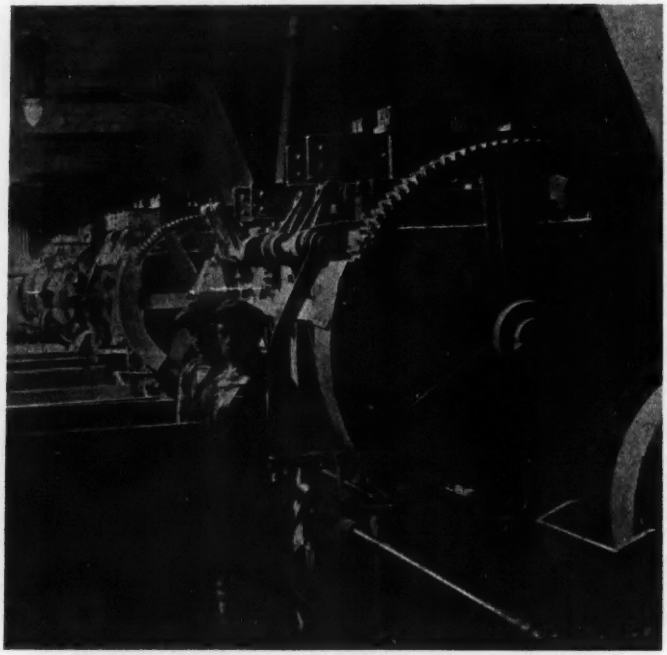


Charging Floor of Schneider Kilns.

chimney was carried on the outer walls of the kiln to allow for the contraction and expansion in working the kiln, which thus had little if any effect upon the life of the kiln body. The firing holes were placed at intervals around the kiln and slanted downwards so as to deliver the coal below the clinkering zone. It was claimed that cement was successfully burnt in this kiln with an expenditure of coal equal to some 15 to 20 per cent. of the clinker produced, whilst the labour involved was also said to be small compared to other kilns of the period.

The Stein kiln is made up of a number of concentric cast-iron rings, laid one on the other to form a parallel tube about 40-ft. high by about 8-ft. internal diameter, the inside surface being smooth and the outside formed as a series of vertical gills for the purpose of keeping the rings cool and preventing them from burning or melting. The bottom of the kiln is fitted with bars in such a way that the clinker can be drawn when wanted, and yet kept sufficiently open to provide the necessary draught. Doors are fitted so that the bottom of the kiln can be made air-tight in order to use forced draught supplied by a special fan if desired. A chimney some 4 ft. in diameter and 10 ft. high draws away the gases from the top of the kiln.

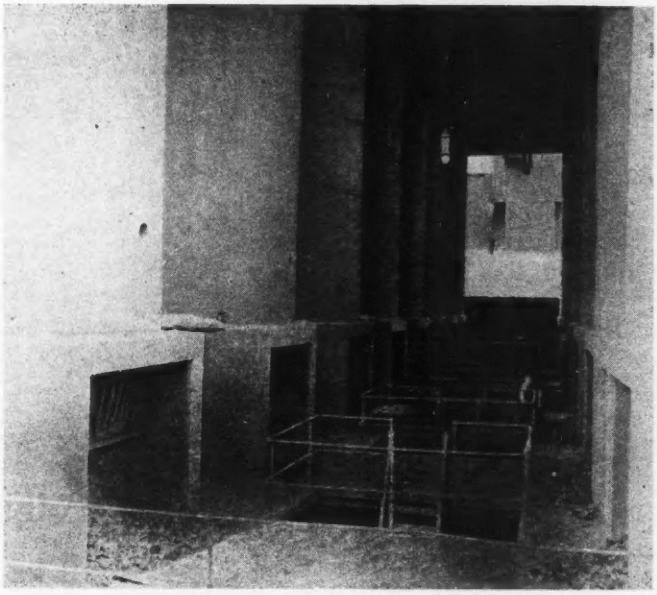
The Stein kiln is economically worked in connection with the dry process, burning dry or even damp bricks. The clinker is drawn at four to six-hour



Presses for Briquetting Raw Materials for Schneider Kilns.

intervals, and the kiln is reloaded in alternate charges of ordinary gas-coke and bricks (the usual charge of the latter being 20 to 22 cwts. of dry raw material) from a stage on the loading level.

The Schneider continuous kiln—known also as the " shaft " kiln—was perhaps the most popular of the continuous type in England. It is operated in a similar manner to others of the type, the layers of raw material and fuel being fed into the top of the kiln at the same time that the clinker is drawn from the bottom. The fire zone occupies about the middle third of the shaft, the layers



Clinker Drawing from Schneider Kilns.

of raw material and coke being contained in the upper portion and the clinker in the lower.

The Schneider, or shaft kiln, consists of a brick or concrete cylinder usually 16 ft. in outside diameter and 40 ft. in height from the ground floor to the loading floor. The inside diameter is about 9 ft. The kiln, before being first lighted up, is loaded with bricks or stones to about half-way up, and then preparations for the fire are made. The loading of the coke and raw material proceeds, and the fire is then started through space purposely left in the loading. When once the raw material has burned through the drawing of the " packing " from the bottom commences, and simultaneously further loading of coke and raw material layers proceeds at the top.

Clinker appears at the bottom of the kiln in about three days, and the continual drawing and loading then proceeds about every four hours night and day

so long as it is desired to keep the kiln in operation. The upper heating chamber is fairly large, but the hot zone is relatively small and should not extend over a vertical height of more than 5 or 6 ft. The firebrick lining requires to be protected with care, and a specially-contrived filling ring was designed to enable the burner to surround the raw material with a protective belt of finely-broken slurry or raw flour about 2 in. in thickness, but in practice this ring was little used. This kiln, even in its early form, was both easy to work and very economical in fuel. The yield of clinker might vary from 10 to 12 tons per day, and the coke required would run from 28 to 38 cwts. for this quantity. It was not a very expensive kiln to build, and the cost of repairs was relatively trifling provided care was taken with the linings. In more recent times the kiln was fairly popular in this country for burning cement bricks made by the dry process, which might be put into the kilns direct from the machines, and in some works which used the wet process such kilns were employed for burning surplus slurry from the chamber kilns.

Burning with the Schneider type of continuous kiln is still carried on to some extent, but considerable modifications of the original design have been introduced. In the later processes the raw materials are fed into the cylindrical kiln, and the clinker extracted, by mechanical means.

Another method of working the same kiln is to mix together the raw material and coal or coke-duff and mechanically load the mixture in blocks. The class of coal in this case must be good in order to burn quickly and cleanly in the clinkering zone, and thus enable the necessity for picking of underburnt material from the clinker to be dispensed with.

The clinker, which appeared partly in small blocks and partly in pieces of the size of a walnut, has in later practice to pass through a revolving grate in the bottom of the kiln into small trucks or automatic conveyors, and the output of the kiln by the new method is substantially increased. The grinding of the resultant clinker is done by the ordinary mills with the greatest ease, as the porous state of the product makes it easier to grind than almost any other clinker, thus effecting saving of power necessary for grinding.

The faults of the original Schneider kiln were the high labour cost (though no higher than with other systems mentioned) and the dependence upon coke as fuel. With the improvements mentioned and the introduction of forced draught these drawbacks are done away with in cement practice, and the advantages of the system, such as cost of plant, less expensive fuel, self-drying of raw materials, absence of labour, substantially increased output, as well as the possibility of working the kiln by hand in case of machinery stoppages, all pointed to a prolonged life for this new kiln, or, more strictly speaking, new process of burning with a shaft kiln.

It is natural that every manufacturer should be on the look-out for improvements in kilns for cement making, not only to simplify the working and increase the output but also to effect greater economy in fuel. The earlier Schneider kiln offered advantages in these respects, not only by the smaller cost of plant but also by the better command of the burning operations, but it had the disadvantages that it necessitated the use of a dear fuel (coke) and required a large staff

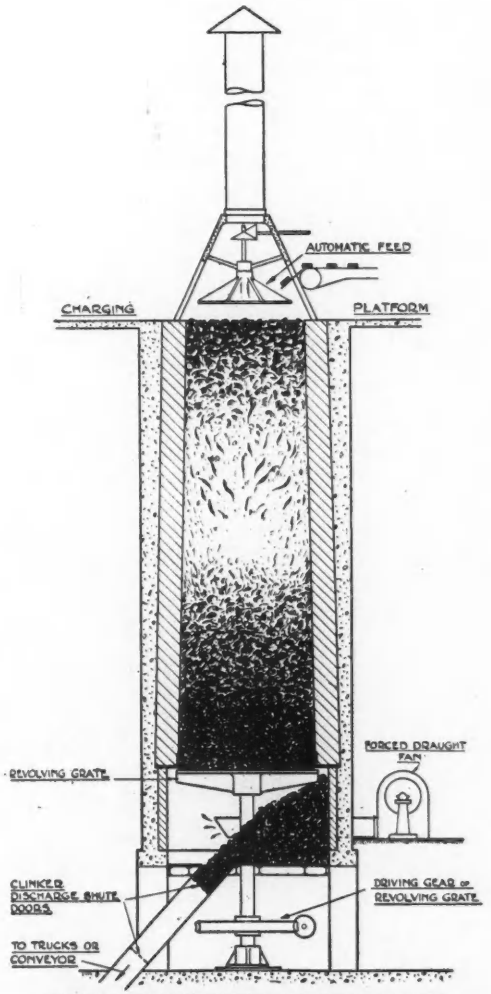


DIAGRAM REPRESENTING SHAFT KILN WITH AUTOMATIC FEEDING & DISCHARGE ARRANGEMENTS

of trained men to work it. These drawbacks the later developments referred to removed to a very large extent, and more particularly abroad the forced draught shaft kiln with the improvements described has been given a new lease of life.

All the continuous kilns mentioned could be used for wet process raw materials, but required drying arrangements by which the slurry might be dried sufficiently to allow of its being moulded into blocks. The amount of fuel necessary for drying is usually somewhat greater than that needed for burning, so that the total amount of fuel required, viz. 30 per cent. to 35 per cent. on the clinker, is not much smaller than was needed for chamber-kilns, but a cheaper kind of fuel, namely, small coal, could be used. In the dry process, however, the continuous kilns show to more advantage.

With the development of the rotary kiln during the past decade it was generally thought that the time had come when the ideal system of burning had arrived, because it enabled the manufacturer to reduce the number of the kiln workmen and to use the cheaper kinds of waste coal instead of expensive coke.

Hungarian Cement Production.

The estimated production of Portland cement in Hungary during 1929 was 600,000 tons, an increase of 75,000 tons over the figure for 1928.

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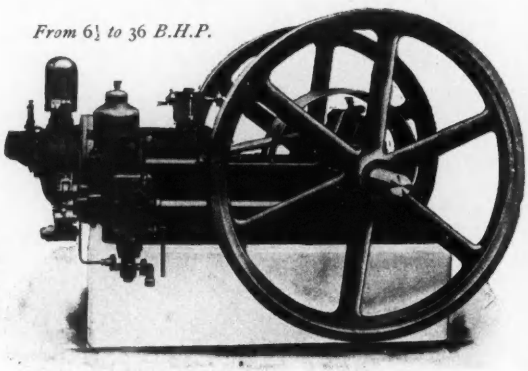

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Abstracts from the Foreign Press.

The Fineness of Cement and its Strength. A. DAHLGREN. *Rev. Matériaux de Construction*, 1929, May, p. 175.

Grinding tests on a given Portland cement clinker show that after a certain fineness has been attained the increase of strength due to finer grinding is not of appreciable importance, except in the case of short-date tests (1 to 3 days). Determinations by means of the action of N/2 HCl of the comparative surface per unit weight of samples of cement ground to various residues on the 4900 per sq. cm. sieve (=180 per linear inch) show that it would not be economical as regards ultimate strength to grind to less than 15 per cent. residue on this sieve. This result is confirmed by direct measurement of the grain size of the samples, and agrees also with the work of J. Dautrebande.

Waste-heat Boilers Fitted with Electrical Dust-Removing Plant. E. OPPEN. *Tonind. Zeit.*, 1929, Vol. 53, p. 816.

A note on the " Oski " waste-heat boiler and electrical dust-removing plant, which has been established in a number of cement works. In the case of an installation of four 130-ft. kilns with an output of 480 tons of cement per day, the " Oski " plant produces 3,500 kilowatts, and recovers 18 to 20 tons of dust per kiln per day.

Calcium Sulphate and its Action on the Mechanical Properties of Cement: Effect of Different Varieties of $CaSO_4$. P. F. BUDNIKOFF and W. M. LESCHOEFF. *Rev. Matériaux de Construction*, 1929, May, p. 182.

Experiments were undertaken to throw further light on the unsettled question as to the amount of calcium sulphate that may be added to Portland cement. Additions of gypsum and insoluble anhydrite ranging from 0.5 to 20 per cent. (of the weight of the mix) were made to a rotary rapid-hardening or high-strength cement, a comparative series of tests being carried out on a normal Portland cement. Tensile and crushing tests were made at 4, 7, and 28 days. The analysis of the high-strength cement was: Loss on ignition 0.87 per cent., CaO 68.53 per cent., SiO_2 24.50 per cent., $Fe_2O_3 + Al_2O_3$ 5.58 per cent., MgO 0.37 per cent. Setting time: initial 2 hours 20 minutes; final 4 hours 45 minutes. All the mixes used proved sound. Results of tensile and crushing tests and of setting times are given in tabular and graphic form.

The best results were obtained with an addition of 4 per cent. gypsum to the high-strength cement: Tensile strengths 567, 912 and 950 lbs. per sq. in. at 4, 7 and 28 days respectively. (Without addition of sulphate the cement gave 412, 471 and 529 lbs. per sq. in.) Excellent tensile results were also obtained with an addition of 2 per cent. anhydrite, viz. 577, 654 and 808 lbs. per sq. in. The best crushing strength was obtained by adding 3 per cent. anhydrite, viz. 7,252 and 10,381 lbs. per sq. in. at 7 and 28 days (the pure cement gave 5,119 and 6,257).

With gypsum the best crushing strengths were obtained with an addition of 2 per cent.

The results obtained by adding 2 to 5 per cent. gypsum or 0.5 to 7 per cent. anhydrite to the high-strength cement were better than those given by a normal Portland cement, while all the results obtained with the high-strength cement were above the requirements of the Russian standard specification for a Portland cement. In almost all the tests with sulphate additions the strengths were above those of the pure high-strength cement. In the case of the anhydrite additions, the strength curves, which show a maximum at 2 to 3 per cent. anhydrite and then fall away sharply, tend to rise again as 20 per cent. anhydrite is approached.

The setting-time curves show that additions of up to 4 per cent. of either modification of sulphate lower the initial setting time. The same applies generally to the final set, with the exception that in the case of gypsum it is retarded by additions of 4, 7 and 20 per cent. 0.5 per cent. gypsum reduces the initial and final setting times to 10 and 15 minutes respectively. These results are opposed to general experience, and further research is required.

With the Portland cement used for the comparison tests the increase in strength resulting from additions of sulphate is not nearly so pronounced as with the high-strength cement; indeed in many cases a decrease in strength results. The best results are obtained with additions of 5 per cent. of gypsum or anhydrite. The effect of gypsum on the setting time of this cement is normal, i.e. the set is retarded.

The theoretical aspect of these results is briefly discussed.

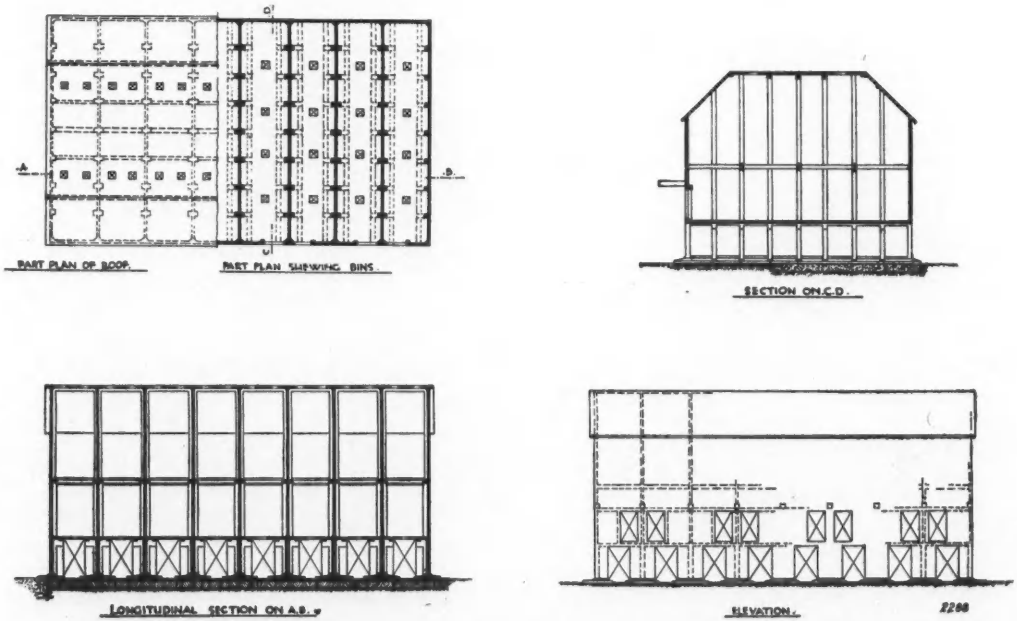
Low-Temperature Distillation of Coal in the Cement Industry. A. SPENGEL. *Tonind. Zeit.*, 1929, Vol. 53, p. 852.

The author recommends a thorough study of the use in cement burning of the coke obtained from the low-temperature distillation of coal. This process, which has now passed the experimental stage, provides a coke, similar in properties to anthracite, of high content of volatile matter (15 to 25 per cent.). It is, however, superior to anthracite in its ready inflammability and powerful flame. Fellner and Ziegler have shown that this coke is more easily ground than coal, while by its means it is easy to work with the theoretical quantity of air. The material is thus ideal for cement burning, and the by-products of the coal distillation are of great value.

The combination of a cement works and low-temperature coal distillation plant is discussed, and costs are given. A further argument in favour of such a combination is that the summer season for cement and the winter season for house coal are complementary.

Reparations Cement.

The German Cement Associations have appointed the " Zement Handelsstelle g.m.b.H." in Heidelberg the central order depôt, and Dr. Schweizer (of the South German Zement Kontor) manager in connection with the " reparations " cement.



New Cement Silos at Barrington.

These silos have recently been completed for Eastwood's Cement Co., Ltd. The building consists of eight silos, with a total capacity of about 5,000 tons, and occupies a site 86 ft. by 51 ft. 6 in.; the height is 32 ft. to eaves and 42 ft. 9 in. overall. The partition walls forming the eight silos are at 10 ft. 6 in. centres and extend the full width of the building

The floor slabs of the silos, approximately 9 ft. above ground level, span between beams supported in cantilevers built out from the wall beams. The consulting engineers are Messrs. Horace Boot & Partners, in collaboration with whom the reinforced concrete details were prepared by the Indented Bar and Concrete Engineering Co., Ltd.

IMPORTS AND EXPORTS OF CALCAREOUS CEMENT FOR AUGUST 1929 AND THE PERIOD JANUARY 1 TO AUGUST 31.

Imports.

—	QUANTITIES IN TONS.						VALUE IN £.					
	MONTH OF AUGUST.			JANUARY 1 TO AUGUST 31.			MONTH OF AUGUST.			JANUARY 1 TO AUGUST 31.		
	1927.	1928.	1929.	1927.	1928.	1929.	1927.	1928.	1929.	1927.	1928.	1929.
	32,509	28,734	25,593	296,140	204,410	190,454	60,151	57,021	47,392	619,591	387,602	352,970

Exports.

To Netherlands	4	1,672	2,864	125	6,425	18,683	26	3,090	5,472	541	10,487	34,336
„ Brazil	4,904	2,127	3,759	24,122	34,047	43,523	12,026	5,170	7,113	58,742	77,596	90,814
„ Argentine Republic ...	5,840	606	13,387	17,320	24,221	61,958	12,596	1,567	24,975	41,506	55,103	128,493
„ Irish Free State ...	12,611	15,247	15,474	72,023	85,935	95,030	43,220	46,042	45,830	234,700	265,955	279,415
„ British West Africa ...	4,834	11,778	6,717	64,945	84,958	56,687	11,705	29,279	16,737	165,414	215,862	140,356
„ „ South Africa	431	316	128	4,011	2,966	2,928	1,396	1,023	416	11,433	9,879	8,774
„ „ India... ...	7,047	6,133	9,460	74,291	60,381	62,565	18,351	14,916	24,069	197,466	154,354	162,016
„ Straits Settlements and Malay States	4,749	5,579	9,368	32,802	67,965	61,111	11,517	13,746	22,558	88,618	166,438	148,263
„ Australia	1,684	1,880	1,296	10,504	14,212	10,864	4,600	5,335	3,530	31,202	38,383	29,674
„ Other Countries ...	29,176	26,305	37,888	178,688	203,253	323,646	71,226	63,282	85,385	468,498	483,522	691,897
Total	71,280	71,643	100,341	478,831	584,363	736,995	186,663	183,450	236,085	1,298,120	1,477,579	1,714,038

"False Set" of Cement.

Mr. F. R. Bogg, Chief Chemist of The Katni Cement and Industrial Co., Ltd., of Katni, India, writes:

" In your April number there is a communication from an American correspondent in connection with the ' false set ' of Portland cement. His comments are interesting, but the explanation of the ' false set ' as being due to the conversion of gypsum to anhydrite owing to the high temperature of the mills can hardly be accepted unreservedly.

" In the November 24 and December 8, 1928, numbers of ' Rock Products ' there are articles by Mr. R. K. Meade dealing with the use of gypsum and anhydrite, in which one of the conclusions given is that gypsum and anhydrite have practically the same retarding effect on Portland cement. In the latter number an article by Mr. E. E. Berger also deals with the question, and the conclusions arrived at are that with anhydrite a higher SO_3 content is required than with gypsum to produce the same retarding effect, and with anhydrite the plasticity of the cement is less. No mention is made of a ' false set ' in either article.

" Whilst on the subject of abnormal sets, I should like to mention a peculiar phenomenon I have noticed in connection with at least two different brands of cement. After both the initial and final sets had taken place by Vicat needle, on removing the test-piece from the mould the cement became quite soft again. On retesting it was found that the final set had not gone, and the initial-set needle penetrated almost completely through the cement test-piece again. In both cases the cement was comparatively fresh (not more than 24 hours after grinding), and in every other respect the physical and chemical tests showed normality. The cements were of quite a different composition chemically. In all cases the phenomenon occurred for a short period, in the case of mill samples only 2 or 3 hours and in the case of average daily samples only for the one day. The act of removing the sample from the setting-time mould seems to have disturbed the equilibrium of the set cement. The first recorded setting times, initial and final, were normal for the particular cement.

" It would be interesting to know if readers have any comments to offer on this phenomenon."

Cement Output of Japan.

In 1928 a total of 3,746,000 tons of Portland cement was produced in Japan, compared with 3,508,833 tons in 1927 and 3,067,500 tons in 1926.

Working Hours in Germany.

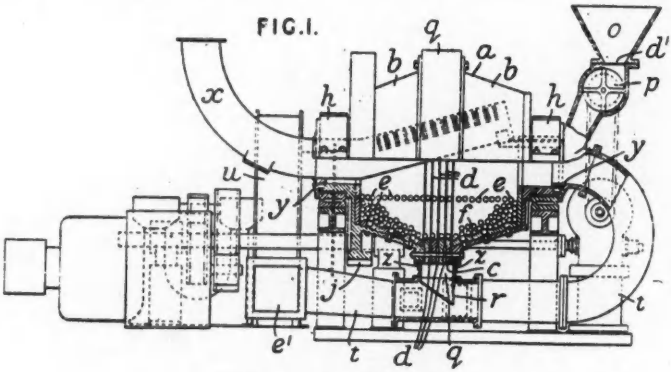
Reuter reports that a new agreement has been made in the Rheinland and Westphalian cement industry fixing a 48 hour week for employees.

Recent Patents Relating to Cement.

Grinding, Crushing, &c., Mills. MULLIN, J., 132, Parsonage Lane, Enfield, Middlesex. April 2, 1928, No. 9959.

In a tube mill (*a*) for pulverising coal, etc., the ground material is discharged through circumferential openings (*d*) intermediate the ends of the cylinder. The mill is mounted on trunnions and may be driven by a gear wheel (*j*). The cylinder comprises two conical ends (*b*) connected by a central portion (*c*) provided with apertures for the discharge of the coal, this central portion being surrounded by a casing (*q*) provided with annular glands (*z*) supplied by air from a fan (*u*). A flap valve (*r*) discharges the ground material into the fan discharge conduit (*t*) which carries the coal dust back through trunnion (*h*) into the mill where the heavier particles are deposited and the fine particles are discharged through an outlet pipe (*x*) passing through the other trunnion. Both trunnions are sealed by chambers (*y*) supplied with air from the fan. The material is fed to the mill through a valve (d^1) and a rotary valve (*p*) provided with a spring clutch in a hopper (*o*) and is ground by balls (*e*) on a corrugated lining (*f*) of steel, rubber, etc. The pulverized material may be burnt direct in a furnace burner, the secondary air for combustion being supplied by a conduit (e^1) from the fan. The intensity of the blast may be regulated by a valve.

FIG. 1.



Grinding and Crushing Mill.

Paper Bags, &c. WILKINSON, G. H., The Red House, Stanley Avenue, Beckenham, Kent; HOLLAND, H. G., La Corbiere, Uxbridge Common; and NEPTUNE WATERPROOF PAPER CO., LTD., Bridge Works, Cowley, near Uxbridge. March 26, 1928, No. 9163 [Class 94 (ii).]

In a bag or sack formed of waterproof material, pitch or other bituminous adhesive is applied to the joints or seams to render them waterproof. Two layers (10, 11) of crepe paper with a layer of pitch, etc., between them are folded over and their edges (12 to 15) interleaved to form a tube, adhesive being sprayed on to the overlapping surfaces either in strips or in patches arranged in staggered relationship. A piece of scrim or hessian may protect the outermost edge (16). The seams may be sewn with thread, string, or wire, and subsequently treated with the adhesive, and the string, etc., may be treated with the adhesive before use. In forming the bottom of

FIG. 1.

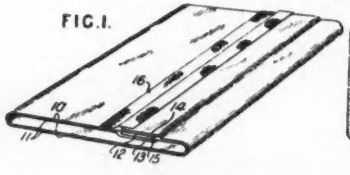


FIG. 4.

Paper Bags

the bag, the corners (19) are folded inwardly between the sides, one bottom edge (20) is folded inwardly, and the other bottom edge is folded over on to the opposite wall of the bag, adhesive being applied to each fold.

[The foregoing are taken from "The Illustrated Official Journal" (Patents) by permission of H.M. Stationery Office. Copies of full Specifications may be obtained from the Patent Office, 25, Southampton Buildings, W.C.2, price 1s. each.]

Company Report and Accounts.

Eastwoods Cement, Ltd.

THE fourth annual accounts of Eastwoods Cement, Ltd., for the year ended March 31 last cover the first full working year of the Company. They show a net profit of £12,404 (against an excess of revenue over expenditure of £8,866 for 1927-28), and adding £11,121 brought forward and deducting £10,000 for the interim dividend already paid, there is now £13,526 to be dealt with. It is proposed to pay a final dividend of 5 per cent., making 10 per cent. for the year (against nil), and to carry forward the balance of £3,526, subject to directors' additional remuneration. During the year the loan of £100,000 guaranteed by his Majesty's Treasury under the Trade Facilities Acts has been taken up, and is being used for financing the recent plant extensions and for general purposes.

At the annual general meeting, held in London on September 5, Mr. Horace Boot (Chairman), in moving the adoption of the report, said on this occasion they presented for the first time the results of a full year's operations of the cement plant at Barrington and a full 12 months' sales. To-day they had the two-kiln plant completely erected and ready to come into commercial operation as soon as certain further extensions of their storage and handling arrangements were completed. The total assets of the Company were valued at no less than £355,724.

The Company possessed at Barrington a freehold of about 150 acres of cement marl. It was easily available, cheaply worked, and practically inexhaustible, and lent itself naturally to the manufacture of Portland cement.

The tonnage of cement sold during the past year exceeded that of the previous accounting period by over 100 per cent., and the board were informed that the figures for the current period were equally satisfactory.

The report was adopted unanimously.

New Company Registered.

EASTWOODS LEWES CEMENT, LTD. (240,505). Registered June 21st. 47, Belvedere Road, Lambeth, S.E. To enter into an agreement with the Lewes Portland Cement and Lime Co., Ltd. Nominal capital, £120,000. Directors: H. Boot, Clarefield Court, Maidenhead; A. Batchelor, Broadview, Blatchington, Seaford, Sussex; and E. A. Glover, Greenacre, Ringmer, Sussex.

Proposed Cement Duty in Latvia.

A bill is awaiting the approval of the Latvian Parliament increasing the import duty on cement from 60 santimes per 100 kilos to 150 santimes (4s. 8d. to 11s. 8d. per ton). There is only one cement plant in Latvia, *viz.*, the Riga Portland Cement Company, with an output of 35,000 tons per annum, while the consumption is estimated at 60,000 tons.

Increased Demand in Hong Kong.

At the recent annual meeting of the Green Island Cement Co., Ltd., the chairman stated that business for the first eight months of the year under review was exceedingly poor, as although enquiries were plentiful the company was unable to meet competition owing to its high cost of production, brought about first by the obsolete plant at Hok Un and, second, by the fact that having accumulated large stocks of cement the company was unable to keep its factories running full time. In September, however, a strong demand set in both locally and from abroad. This demand enabled the concern not only to dispose of all accumulated stocks, but also to commence running both factories full time, thus materially reducing costs. So strong had this demand become that for the past three months the company have been daily turning away orders.

The late Mr. W. A. T. Flitton.

THE death took place of Mr. W. A. T. Flitton, manager of the Penarth Works of South Wales Portland Cement & Lime Co., Ltd., on August 21, very suddenly while driving his car.

Trade Notice.

Vickers, Ltd.—A brochure giving lists of the products of Messrs. Vickers, Ltd., and its many associated companies has been issued from Vickers House, Broadway, London, S.W.1. The cement manufacturer will be particularly interested in the wide range of cement-making plant listed, covering every phase of the manufacturing processes.

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